REMARKS

The Office action, dated as mailed February 10, 2005, addressed claims 1-20. Claims 5-7, 9, 15 and 19 were objected to, claims 1-5 and 8 were rejected under 35 USC §102(b) and claims 6, 7, and 9-20 were rejected under 35 USC §103(a). In response, the specification is amended above to correct an informality and claims 1-3, 5, 6, 8-15 and 18-20 are amended above to more particularly point out and distinctly claim Applicants' invention. Accordingly, claims 1-20 remain pending in the present application.

Prior to responding to the substance of the Office action, it is useful to recapitulate the invention as claimed.

The Claimed Invention

As illustrated in Figures 1 through 3, the claimed invention contemplates a lantern flashlight power source adaptor (10), which may be used with a single battery (12) that has an end (26) and an electrical socket (48) and, that comprises a member (14) that, in turn, comprises a plate portion (22) that has an outer periphery and a plurality of side wall portions (24) extending substantially from the entire outer periphery of the plate portion and that is engageable with the end of the battery. The adaptor (10) also comprises an electrical plug (20) that is supported by the member (14) and comprises a generally tubular shaped shield (44) defining a cavity and a plurality of pins (46) disposed within the cavity. Also, the electrical plug (20) is dimensioned and configured to be connectable

with the electrical socket (48) of the battery (12) and the adaptor also comprises at least one solderless electrical terminal connector (16) that is connected in circuit with the electrical plug and that is located on the member (14).

In one application, the adaptor of the present invention facilitates the use of partially depleted, high voltage, military batteries which have been found to have enough remaining energy to operate lantern flashlights which are commonly employed by a typical Army unit.

The Objections to Claims 5-7, 9, 15 and 19

Claims 5-7, 9, 15 and 19 each stand objected to for minor informalities.

Regarding claims 6, 7 and 9, each of claims 6 and 9 are amended above in a manner believed to overcome each respective objection.

With respect to claims 5, 15 and 19, each of these claims were objected to as containing an industry standard "BA-5590" which is asserted to render these claims indefinite. However, Applicant respectfully submits that the term "BA-5590" does not render these claims indefinite as this term has a definite and ascertainable meaning as understood at the time of filing of the present application in accordance with MPEP §608.01(v), which is applied by analogy. In particular, Attachment A comprises MIL-PRF-49471(ER), dated 2 June 1995, which describes in detail the particular performance specification for the BA-5590 battery and Applicants intend that claims 5, 15 and 19 shall be construed in light of the present specification and this performance specification for the purposes of clarity. If there is any further question concerning the clarity of claims 5, 15 and

19, the Examiner is respectfully requested to contact the undersigned via telephone.

The Rejection of Claims 1-5 and 8 Under 35 USC §102(b)

Claims 1-5 and 8 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 5,259,786 to Huang[1], (below referred to as "Huang"). However, Applicants respectfully traverse the rejection as Huang fails to teach or suggest a member comprising a plate portion having an outer periphery and a plurality of side wall portions extending substantially from the entire periphery of the plate portion, an electrical plug comprising a generally tubular shaped shield having a cavity and a plurality of pins disposed within the cavity or at least one solderless electrical terminal connector in circuit with the electrical plug as defined by Applicants' claim 1 as now amended.

Huang

As illustrated in Figures 2 through 4, Huang describes a lamp unit battery seat which has a back plate 15 that includes a pair of lips 33 and 34 having a respective upper terminal 35 and lower terminal 36. The upper terminal 35 is electrically connected with an electrical connector 53 via a wire 54 which is soldered thereto along with a wire 56 which, via a switch 46, may be electrically connected with a lamp bulb 11. The lower terminal 36 is electrically connected

[1] It is noted that the Office action refers to U.S. Patent No. 5,359,786, although, in view of the form PTO-892, which cites U.S. Patent No. 5,259,786 to Huang, the former is understood, by Applicants, to be a typographical error.

with an electrical connector 52 via a wire 55 which is soldered thereto along with wire 49 which, is in turn, connected with a lamp bulb 11.

It is important to note that Huang teaches that the lips 33 and 34 extend only from opposing side edges of the back plate 15, that the upper terminal 35 and the lower terminal 36 should be separated one from another for connection with a similarly configured battery (C) and that a solder connection must be made with the electrical connectors 52 and 53.

Discussion

Applicants respectively submit that claim 1 is not anticipated by Huang as Huang fails to teach or suggest a plate portion having an outer periphery and a plurality of side wall portions extending substantially from the entire periphery of the plate portion as recited in Applicants' claim 1. In contrast, Huang teaches a back plate 15 having lips 33 and 34 extending from opposing side edges thereof.

Also, Applicants respectively submit that claim 1 is not anticipated by Huang as Huang fails to teach or suggest an electrical plug comprising a generally tubular shaped shield having a cavity and a plurality of pins disposed within the cavity as recited in Applicants' claim 1. In contrast, Huang teaches separation of the upper terminal 35 and the lower terminal 36 for connection to a similarly configured battery (C).

Further, Applicants respectively submit that claim 1 is not anticipated by Huang as Huang fails to teach or suggest at least one solderless electrical terminal connector in circuit with the electrical plug as recited in claim 1. In

contrast, Huang teaches that solder connection must be made using the electrical connectors 52 and 53. Indeed, these connectors connect wires and, as such, include solder for a permanent connection of the wires within the lamp housing 10 and, therefore, teaches away from a solderless, non-permanent type of connection as claimed by Applicants for allowing use of the adaptor with various items such as flashlight lamps.

Accordingly, Huang does not show a member, an electrical plug or a solderless connection as defined in Applicants' claim 1 and, therefore, does not anticipate, nor render obvious, Applicants' independent claim 1. Moreover, it has long been held by the Court of Appeals for the Federal Circuit that patentability may reside in a new combination of old elements. For example, see *Envtl. Designs, Ltd. V. Union Oil Co.*, 713F.2d 693, 698 (Fed. Cir. 1983) (noting that "virtually all [inventions] are combinations of old elements.")

Concerning each of claims 2-5 and 8, since each of these claims depend from what should be an allowable independent claim 1, each of these claims should also be allowable for the reasons provided above. Also, each of these dependent claims recite patentable features not taught or suggested by Huang. For example, claim 2 recites solderless connectors, claim 3 recites a gasket for providing a water tight seal, claim 4 recites a holding strap, claim 5 recites a particular configuration of the electrical plug and the battery and claim 8 recites a recessed portion of the plate wherein a circuit board is located and an electrical disconnect circuit configured to disconnect the battery from the at least one solderless electrical terminal connector.

The Rejection of Claims 6 and 7 Under 35 USC §103(a)

Claims 6 and 7 stand rejected under 35 USC §103(a) as being unpatentable over Huang. However, Applicants respectfully traverse the rejection as both claims 6 and 7 depend from what should be an allowable independent claim 1, therefore, each of these claims should also be allowable for the reasons provided above.

The Rejection of Claim 9 Under 35 USC §103(a)

Claim 9 stands rejected under 35 USC §103(a) as being unpatentable over Huang in view of U.S. Patent No. 6,508,313, to Carney et al (below referred to as "Carney"). However, Applicants respectfully traverse the rejection as neither Huang nor Carney teach or suggest a member, an electrical plug or a solderless connector as defined by Applicants' independent claim 1 from which claim 9 depends, nor do either teach or suggest a comparator that is configured to open an electrical disconnect circuit when a battery voltage reduces to approximately ten volts to prevent the venting of toxic substances from the battery. Also, Applicants have an earlier invention date than the July 23, 2001 filing date of Carney and thus would file a 37 CFR §131 Declaration to swear behind Carney should the Examiner choose to employ this patent in a subsequent action. Because of the above amendments to claims 1 and 9 and the below discussion it is believed that, at this time, it is not necessary to provide such a Declaration, but, Applicants reserve the right to do so at a future juncture.

Carney

Referring to Figures 1 and 3, Carney describes an impact tool 10 powered by a battery pack 20 that is electrically connected via a trigger circuit 40. The trigger circuit 40 includes an IC comparator 45 that is employed to enable a timer circuit 50 upon receipt of vibrations, via a microphone 41, caused by the tool 10 during use. In essence, the trigger circuit 40 functions to sense when impact tool 10 begins to supply a significant amount of torque to a fastener and thereafter enables a timing circuit which temporarily disconnects the battery.

Discussion

Applicants respectfully submit that claim 9 is patentable over the combination of Huang and Carney as neither of these patents teach or suggest Applicants' claimed invention including the combination of a member, an electrical plug, a solderless connector and a comparator that is configured to open an electrical disconnect circuit when a battery voltage reduces to approximately ten volts to prevent the venting of toxic substances from the battery. In contrast, the comparator of Carney enables a timing circuit upon the sensing of increased torque through vibrations and temporarily disconnects the battery. Therefore, the combination of Huang and Carney does not render obvious Applicants' claim 9.

With specific regard to the Examiner's motivational statement that the comparator and related circuitry of Carney may be employed to extend the life of

a battery employed with Applicants' adaptor, in contrast and as described above, Carney teaches sensing vibrations and responds thereto by use of a comparator to enable a timing circuit for temporarily disconnecting a battery. As now amended claim 9 makes clear that, based on a sensed voltage of the battery, the comparator disconnects the battery to prevent the discharge of toxic materials.

The Rejection of Claims 10-20 Under 35 USC §103(a)

Claims 10-20 stand rejected under 35 USC §103(a) as being unpatentable over Huang in view of U.S. Patent No. 5,250,891, to Glasgow (below referred to as "Glasgow"). However, Applicants respectfully traverse the rejection as neither Huang nor Glasgow teach or suggest a member, an electrical plug or a solderless connector as defined by Applicants' independent claims 1, 11 and 18, and the combination of Huang and Glasgow would not replicate Applicants' claimed invention including an adaptor usable with a single battery, a DC voltage downconverter circuit for reducing an output voltage of a battery that is connected in circuit between an electrical plug and a solderless electrical terminal connector or an electrical disconnect circuit configured to disconnect the battery from the at least one solderless electrical terminal connector and being connected in circuit with the electrical plug as recited in claim 10 (see also claim 8) and independent claims 11 and 18.

Glasgow

As illustrated in Figure 1, Glasgow describes a battery charging circuit 10 for charging a battery pack 12 and has a step-down converter 15 operative to provide various lower output voltages to the battery pack to be charged. A thermoswitch 18 is provided, which based on battery pack temperature, terminates charging of the battery pack upon the same reaching a predetermined temperature.

Discussion

Applicants respectfully submit that dependent claim 10 and independent claims 11 and 18 are each patentable over the combination of Huang and Glasgow as neither of these patents teach or suggest Applicants' claimed invention including the combination of a member, an electrical plug, a solderless connector as defined by Applicants independent claims along with a DC voltage downconverter circuit for reducing an output voltage of a battery that is connected in circuit between an electrical plug and a solderless electrical terminal connector or an electrical disconnect circuit configured to disconnect the battery from the at least one solderless electrical terminal connector and being connected in circuit with the electrical plug. To begin with, Huang is described above as failing to replicate Applicants' claimed invention and Glasgow fails to cure the deficiencies of Huang. In contrast, Glasgow merely describes a circuit for charging batteries.

Also, Applicants respectfully submit that the combination of Huang and Glasgow would not replicate Applicants' claimed invention. Instead, the

combination of the teachings of Huang and Glasgow would result in a multi-battery system including a battery operated and a separate battery charging circuit that would require a soldered connection to the soldered terminal connectors 52 and 53 of Huang which may charge the Huang's battery C but would not teach or suggest providing an adaptor usable with a single battery (see Applicants' preamble to each independent claim), a downconverter circuit for reducing an output voltage of a battery that is connected in circuit between an electrical plug and a solderless electrical terminal connector or an electrical disconnect circuit configured to disconnect the battery from the at least one solderless electrical terminal connector and being connected in circuit with the electrical plug as claimed by Applicant.

Regarding each of claims 12-17, 19 and 20, since each of these claims depend from what now should be allowable independent claims 11 and 18, each of these claims should also be allowable for the reasons provided above. Also, each of these dependent claims recite patentable features not taught or suggested by Huang or Glasgow. For example, claim 12 recites solderless connectors, claim 13 recites a gasket for providing a water tight seal, claim 14 recites a holding strap, claims 15 and 19 each recite a particular configuration of the electrical plug and the battery.

Conclusion

In view of the foregoing, Applicants respectfully request reexamination, reconsideration and allowance of each of pending claims 1 through 20.

The undersigned attorney may be contacted at the number below to facilitate the resolution of any remaining matters.

Respectfully submitted,

By: _____
Roger C. Phillips, Reg. No. 37,418
Attorney for Applicants

Date: April 12, 2005

U.S. Army Communications Electronics Command
AMSEL-LG-L (Phillips)
Fort Monmouth, NJ 07703

ATTACHMENT A

INCH-POUND

MIL-PRF-49471/3(ER)
2 June 1995

PERFORMANCE SPECIFICATION SHEET

BATTERY, NON-RECHARGEABLE, HIGH PERFORMANCE, BA-X590/U

This specification is approved for use within Army Research Laboratory, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product herein shall consist of this specification sheet and the issue of the following specification listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation: MIL-PRF-49471(ER).

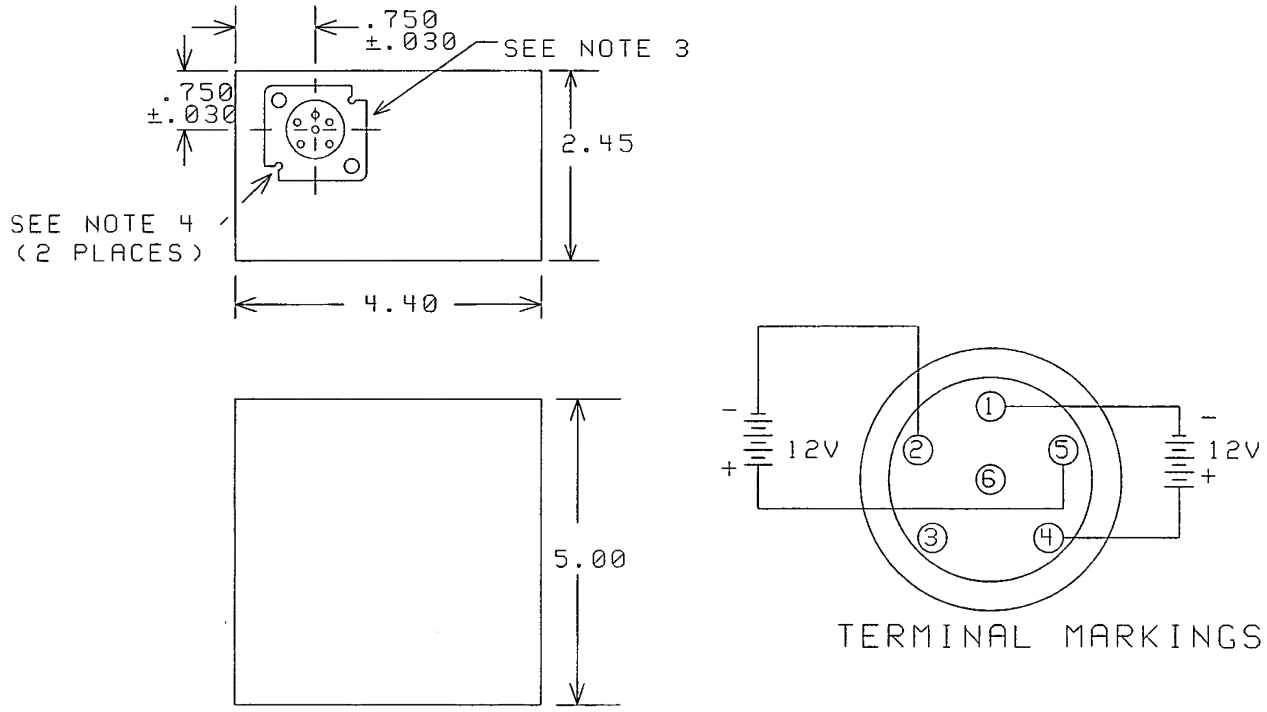

Figure 1. Battery dimensions.

NOTES:

1. All dimensions are in inches.

2. Tolerances, unless otherwise specified, are -0.063, +0.000.

3. The battery terminal shall consist of a miniature circular battery connector per Dwg. SC-C-179492 or equal. Connector shall be mounted in accordance with referenced drawing.

4. Connector socket body configuration shall accept two (2) each 0.156 inch diameter guidepost as shown. Depth of cavity shall be 0.657 inch minimum.

5. The socket shall be supported and mounted so that the top surface of the socket shall not protrude above the adjacent outside surface of the jacket and shall not be more than 0.0625 inch below adjacent outside of the jacket when used initially, during, and after subsequent insertions of the mating plug during contractual testing.

REQUIREMENTS:

Dimensions and configuration: See Figure 1.

Maximum voltage: 30.50 volts in 24 volt mode
15.25 volts in 12 volt mode

Minimum voltage for capacity: 20.00 volts in 24 volt mode
10.00 volts in 12 volt mode

Charge protection device: Applicable.

Safety feature: Applicable.

Terminals: Six (6) hole socket type with no obstruction of any holes (see Fig. 1).

Weight (maximum): 2.33 pounds (1058 grams).

Capacity tests: When the battery is tested in accordance with the methods of examination and tests of this specification, the minimum capacity test requirements shall be as specified below:

Capacity Test*	Minimum Capacity Requirements in Hours to 20.00 volts in Series, 10.00 volts in Parallel
I & IP	3.4
L & LP	2.2
H & HP	5.6
HT & HTP	5.4
LT & LTP	2.0
IT & ITP	3.0

*NOTE: Sample batteries that are to be assigned to a capacity test shall be equally divided between the designated capacity test and the capacity test ending in P (e.g. I and IP). The odd battery, if present, is assigned to parallel discharge capacity test. For the capacity tests that do not have the P's, the battery's legs shall be discharged in series. For the capacity tests that have the P's, the battery's legs shall be discharged in parallel.

Initial voltage delay: During the I, H, HT, and IT discharge tests of the two (2) 12 volt sections connected in series under the designated loads, initial voltage below the 20.00 volt minimum voltage cannot exceed a 5.0 second duration. During L and LT discharge tests initial voltage below 20.00 volts cannot exceed a 60 second duration. During the IP, HP, HTP, and ITP discharge tests of the two (2) 12 volt sections connected in parallel under the designated loads, initial voltage below the 10.00 volt minimum voltage cannot exceed a 5.0 second duration. During LP and LTP discharge tests initial voltage below 10.00 volts cannot exceed a 60 second duration.

High temperature device: Applicable.

Complete discharge device: Applicable.

Connector: The connector shall be in accordance with SC-C-179492 or equivalent with the following exception: The durability test described in paragraph 4h shall be performed 50 times with SM-D-687888 or equivalent. Each of the metallic sockets in the connector (top view) shall conform to Figure 2. Each socket shall be cylindrical in shape and may have a single gap with a maximum opening of 30 degrees. The socket shall accept a number 16 pin.

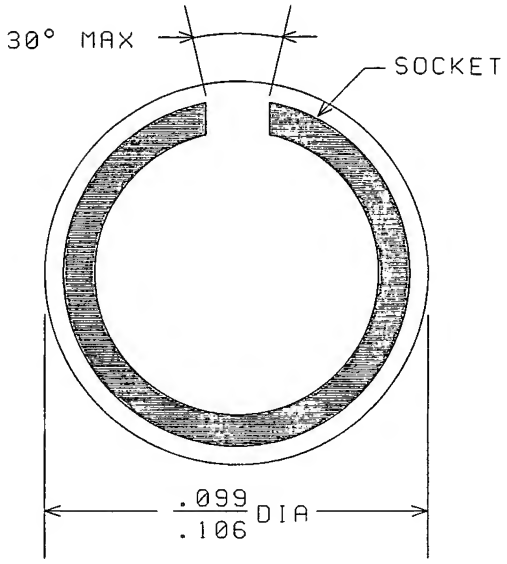

Figure 2. Socket (Top View).

METHOD OF EXAMINATION AND TESTS:

Capacity tests:

(1) Storage:

Details on storage conditions for all specified capacity tests are described in the basic specification.

(2) Discharge:

Cells (forced discharge): Two cells shall be discharged at 2.0 amperes at 70±5°F to 2/3 of open-circuit voltage. Each discharged cell shall then be connected in series to nine fresh cells. Each string shall be discharged at 2.0 amperes at 70±5°F to 2/3 open-circuit voltage of the nine fresh cells.

Batteries: For all capacity tests that do not end in P, except the H and HT, the batteries shall be discharged in the 24 volt mode by connecting pins 2 & 4 and discharged between pins 1 & 5 at two amperes constant current to zero volts. For the H and HT capacity tests the batteries shall be discharged in the 24 volt mode as described above, at two amperes for five minutes, followed by open-circuit for five minutes. This cycle shall be repeated until the closed-circuit voltage reaches zero volts.

For all capacity tests that end in P, except the HP and HTP, the batteries shall be discharged with the two 12 volt sections connected in parallel at four amperes constant current to zero volts. For the HP and HTP capacity tests the batteries shall be discharged with the two 12 volt sections in parallel at four amperes constant current for five minutes followed by open circuit for five minutes. This cycle shall be repeated until the closed-circuit voltage reaches zero volts.

Closed-circuit voltage: Load resistance of 6.0 ohms shall be used between socket holes 1 & 4 and 2 & 5. Voltage shall be 11.70 volts or greater within twenty seconds.

Custodian
Army - ER

Preparing Activity:
Army - ER

(Project 6135-A274-03)

INCH-POUND

MIL-PRF-49471(ER)
2 June 1995

PERFORMANCE SPECIFICATION

BATTERIES, NON-RECHARGEABLE, HIGH PERFORMANCE

This specification is approved for use within Army Research Laboratory, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers non-rechargeable batteries of the non-reserve type composed of electrochemical cells (see 6.1).

1.2 Classification.

1.2.1 Type designation. The type designation of non-rechargeable batteries shall be in the following form (see 3.1). For example:

BA-	5590	/U
Component	Battery Type number	Installation indicator
(1.2.1.1)	(1.2.1.2)	(1.2.1.3)

1.2.1.1 Component. Non-rechargeable batteries are identified by the two-letter symbol "BA" followed by a hyphen.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Research Laboratory, ATTN: AMSRL-PS-DC, Fort Monmouth, New Jersey 07703, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6135

1.2.1.2 Battery type number. The battery type number identifies the basic design of the battery (see 3.1) and consists of a four digit number.

1.2.1.3 Installation indicator. The installation indicator identifies equipment the battery is used in, i.e., /PRC-25 or if "universal", i.e., /U indicates use in various equipment.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

(See Supplement 1 for list of associated specifications sheets.)

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Defense Printing Service Detachment Office, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5093.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

UL-1642 Standard for Lithium Batteries

(Applications for copies should be addressed to the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein except for specification sheets, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.3).

3.3 Materials.

3.3.1 Metals. All metals which do not enter into the basic electrochemical reaction of the cell shall resist, or be treated to resist, corrosion.

3.3.1.1 Dissimilar metals. When dissimilar metals which would adversely affect battery performance are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided.

3.3.2 Insulating compounds - flow or shrinking. When tested as specified in 4.7.14 the insulating, impregnating, potting and sealing compounds shall not flow at high temperature, nor crack or draw away from the sides of a container at low temperature. Any compound used shall be non-flammable and non-toxic. Potting shall not inhibit cell vent operations (see 4.7.10).

3.3.2.1 Electrical connection wires and tabs. All electrical connecting wires and tabs for the cells and the battery shall be covered by an insulation with the following characteristics:

Softening temperature: 302°F (150°C) minimum
Lengthwise shrinkage: 3% maximum after application
Thickness: 0.005 inch minimum

The material shall be non-flammable and non-toxic.

3.4 Design and construction. Batteries shall be of the design, construction, physical dimensions, weight, and polarity as specified in 3.1.

3.4.1 Intercell connections. Intercell connections shall be connected in accordance with the contractor's established procedures. These procedures shall be developed by the contractor as part of the quality program requirements of the contract. Intercell conductors shall be insulated to prevent or preclude short circuiting within a multi cell battery. The cell series insulation resistance shall not be less than 25 megohms when tested as specified in 4.7.8.

3.4.2 Shelf life. The manufacturer shall certify that the battery is capable of delivering 85 percent of the minimum capacity (see 3.1) after 60 months of casual storage.

3.4.3 Insulation resistance (battery terminals and cell series string). Terminals shall be as specified on the applicable specification sheet (see 3.1) and insulation resistance shall be not less than 25 megohms when tested as specified in 4.7.8.

3.4.3.1 Cell positive terminal coating. The positive terminal of each cell shall be coated with a non-conducting compound which is impervious to moisture. The compound shall meet the requirements specified in 3.3.2.

3.4.4 Safety features.

3.4.4.1 Cell. Each cell of the battery shall contain a feature so that any potentially explosive condition caused by sustained heating shall cause the safety feature to activate and thus preclude an explosion. This feature shall operate between 205°F and 300°F (see 4.7.10).

3.4.4.2 Battery leg. Unless otherwise specified (see 3.1), each battery or each leg within a multi-leg battery shall contain a mechanism that will open under the following conditions (see 4.7.10):

- 4 hours, minimum when subjected to 110% of the devices rated current.

- 10 seconds, maximum when subjected to 200% of the devices rated current.

Batteries shall not be constructed using parallel arrangements of cells.

3.4.5 High temperature device. A non-resettable high temperature device is required. The device shall remain closed below 180°F and shall remain open at 195 $\pm$5°F (see 4.7.10).

3.4.5.1 High temperature device location. The high temperature device shall be located as close as possible to the geometric center of the battery or as indicated below. For a two or three cell in-line arrangement, the high temperature switch or thermal fuse shall be located between any two adjacent cells. For a cluster arrangement of three or more cells, the high temperature switch or thermal fuse shall be located at the geometric center of the cluster (see 4.7.10).

3.4.5.2 Charge protection. Unless otherwise specified (see 3.1), each battery or each leg in a multi-leg battery shall contain a device that prevents reverse currents in excess of 2.0 milliamperes (see 4.7.10.2).

3.4.5.3 Complete discharge device. Unless otherwise specified (see 3.1), each battery shall contain a device that shall completely discharge the battery rendering it non-reactive for disposal purposes within 5 days after activation. The top surface of the device shall be 3/16 inch minimum and 1/4 inch maximum below the outer surface of the battery where the slot is located. The activation device shall emit an audible click or travel a minimum of 1/16 inch after activation. The intent is to alert the user that the device has been activated. The effective hole size shall be accessible by a flat blade screwdriver. The hole shall be covered by a removable label (see 3.12.3). After testing as specified in 4.7.10.1, the batteries shall read less than 1 volt and shall exhibit no signs of distortion, swelling, rupture, or venting.

3.4.6 State of charge. The battery shall contain a state of charge indicator, when specified. A device that measures the state of charge (i.e. remaining capacity) shall be incorporated in the battery. If any battery fails any one reading, retest with a new set of samples. If any battery fails any one reading during the retest, the batteries have failed the test. As a minimum, the state of

charge shall be displayed as three distinct ranges of remaining capacity in the battery (see 4.7.19). The three ranges shall be:

1) less than 20 percent
2) 20 to 70 percent
3) greater than 70 percent

3.4.6.1 State of charge indicator. The mechanism for displaying the state of charge shall be located on one of the faces of the battery that is perpendicular to the face that contains the connector. The state of charge display mechanism shall not be located on the same face as the connector. A label or equivalent shall be located on the same face of the battery. This label or equivalent shall describe the method for reading the state of charge mechanism.

3.4.7 Battery enclosure. The battery enclosure shall be a non-metallic material that does not support combustion when subjected to flame.

3.4.7.1 Battery enclosure (plastic). Plastic battery enclosures shall exhibit no signs of cracking, breaking, swelling, or distortion after testing per 4.7.11.1.

3.4.7.2 Color of jackets. The color of exposed surfaces of jackets shall be lusterless green. Examples of lusterless greens may be found in 6.5.

3.4.8 Connectors. Connectors shall be as specified on the applicable specification sheet. Location of the connectors shall be verified as specified in 4.7.15. Only sockets which are electrically connected shall require electrical contacts.

3.4.8.1 Socket strength (when specified). After the batteries have been tested as specified (see 3.1), they shall meet the open-circuit voltage, jacket integrity, and visual and mechanical requirements (see 3.5.1, 3.4.7 and 3.4).

3.5 Battery voltages.

3.5.1 Battery open-circuit voltage. The open-circuit voltage shall not exceed the maximum voltage specified (see 3.1 and 4.7.2.1).

3.5.2 Battery closed-circuit voltage. The closed-circuit voltage shall be not less than the minimum voltage specified (see 3.1 and 4.7.2.2).

3.5.3 Cell closed-circuit voltage. When cells are tested as specified in 4.7.12, the voltage shall be above two-thirds of the open circuit voltage at the completion of the test.

3.5.4 Cell series string voltage. When any cells are connected in series prior to assembly into a battery with more than one section, they shall be subjected to a closed circuit voltage test to insure proper electrical contact among the cells (see 4.7.12.1).

3.6 Capacity. When the battery is tested for capacity as specified in 4.7.9 the time required to reach its specified minimum voltage shall be not less than the minimum capacity requirement specified (see 3.1). If a voltage delay occurs when the battery is tested for capacity as specified in 4.7.9, the calculated time will start when the battery reaches the minimum voltage for capacity, on the rise and will end when the battery reaches its minimum voltage as the voltage falls. A failure shall be defined as below:

a. The battery voltage or the voltage of any one leg falls below the specified minimum voltage prior to exceeding the capacity required or fails to reach minimum voltage in the required time. Any safety device operates before the I, L, H, HT, LT, or IT test is complete. During IP, LP, HP, HTP, LTP, or ITP test operation of safety devices after cut-off voltage is reached shall not be considered a failure.

b. Excessive initial voltage delay.

c. Battery exceeds dimensional tolerances after discharge.

d. Battery vents, leaks, burns or ruptures.

3.6.1 Initial voltage delay. When the battery is tested for capacity, the time required at the beginning of discharge for the battery or its legs to meet the specified minimum battery voltage after the load is applied shall be not more than the time specified (see 3.1 and 4.7.9.1.1).

3.7 Cell electrolyte leakage. Each cell shall have a leakage amount as specified below:

a. For solid cathode systems: The leakage amount shall not exceed 1.0% of the total electrolyte in the cell when tested as specified in 4.7.13.

b. For liquid cathode systems: The leakage amount shall not exceed 0.005% of the total electrolyte in the cell when tested as specified in 4.7.13.

3.7.1 Cell forced discharge. After the cells have been tested as specified in 4.7.18, there shall be no leaking, venting, fire, or explosion.

3.8 Vibration. After the batteries have been tested as specified in 4.7.6 they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

3.9 Mechanical shock. After the batteries have been tested as specified in 4.7.5 they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

3.10 Drop test. After the batteries have been tested at each temperature as specified in 4.7.3, they shall meet the battery voltage requirements. No cells shall be visible before or after the tests with a multi-cell battery (see 3.5.1). Following the battery drop test, the socket shall remain within the limits specified on the individual specification sheet (see 3.1).

3.11 Altitude. After the batteries have been tested as specified in 4.7.7 they shall meet the battery open-circuit voltage requirements (see 3.5.1).

3.12 Labeling and marking. All labeling and marking shall be clear and legible throughout all the tests specified herein. Labeling and marking shall be black. Jackets may have the labeling and marking engraved, or die stamped, in which case it may be the same color as background.

3.12.1 Labels. Each battery shall have a label as specified in 3.1. As a minimum, the following information shall be on the label:

BATTERY, NON-RECHARGEABLE, (Chemistry)
Type Designation
(Contract Number)
(Date Code)
Manufacturer's name or Trade name
Manufacturer's location

DO NOT CHARGE, SHORT CIRCUIT, INCINERATE, OR MUTILATE THIS BATTERY
OTHERWISE BATTERY MAY VENT OR RUPTURE RELEASING TOXIC MATERIALS

EXAMPLE:

BATTERY, NON-RECHARGEABLE, LITHIUM SULFUR DIOXIDE
BA-5590/U
DAAB05-95-C-1234
0395B
James E. Doe Company
Bruntherman, N.J.

DO NOT CHARGE, SHORT CIRCUIT, INCINERATE OR MUTILATE THIS BATTERY
OTHERWISE BATTERY MAY VENT OR RUPTURE RELEASING TOXIC MATERIALS

NOTE: The code may be placed on the bottom of single-cell batteries.

3.12.1.1 Date Code. The date code shown shall indicate the month, year and week of manufacture of the battery by means of a four-digit number. This shall be followed by a single letter. The first two digits shall indicate the number of the month. The last two digits shall indicate the year. Months earlier than the tenth month shall be a single digit preceded by "O". The letter shall represent the week of the month. The letter "A" shall be used for the first week of the month, "B" for the second week of the month, etc. Sunday shall be considered the first day of a week.

EXAMPLES:

A battery manufactured during the second week of March 1995 will bear the code "0395B".

A battery manufactured during the third week of November 1995 will bear the code "1195C".

3.12.2 Terminal marking. On batteries having socket-type terminals, all markings required to indicate polarity by a + or - sign, voltage, and the voltage leg of the battery (A, B, C, etc.) shall appear on the face of the battery bearing the socket. On other type terminals, the terminal markings may appear on the surface with the terminal or the side of the battery, or both. Markings shall indicate clearly the terminals to which they refer.

3.12.3 Complete discharge device label. The label shall be removable, transparent and waterproof with lusterless black lettering. The label shall cover the activation device opening. The format shall be as follows:

ATTENTION
Before Disposal
Remove this Label and
Push Activation Device

The word ATTENTION in the top panel shall be in bold lettering and shall fill the available area of the top panel.

3.12.4 Complete discharge device card. The card shall be clearly legible and read as follows:

ATTENTION

THIS BATTERY HAS A DISCHARGE ACTIVATION DEVICE, IN ORDER TO MAKE IT NONREACTIVE. AFTER FINAL USE, REMOVE ATTENTION LABEL COVERING THE ACTIVATION DEVICE, PUSH ACTIVATION DEVICE, AND STORE FOR FIVE DAYS IN A WELL VENTILATED ROOM. THE BATTERIES SHOULD HAVE A MINIMUM OF TWO INCHES BETWEEN THEM DURING DISCHARGE. IF A FRESH BATTERY FAILS TO OPERATE THE EQUIPMENT, DO NOT ACTIVATE THE COMPLETE DISCHARGE DEVICE - DISPOSE OF THE BATTERY AS HAZARDOUS WASTE. COORDINATE DISPOSAL WITH YOUR LOCAL ENVIRONMENTAL OFFICE/OFFICER. STATE/LOCAL REGULATIONS WILL CONTROL DISPOSAL IN YOUR AREA.

The card shall be packaged in the plastic bag containing the battery and the card shall be placed lettering side out. The word ATTENTION shall be in bold lettering.

3.13 Cell water content. Water content inside a cell shall not exceed 800 parts per million by weight. The contractor shall certify that this limit is not exceeded throughout production (see 4.7.17).

3.14 Workmanship. Batteries shall be processed in such a manner as to be uniform in quality and shall be free from defects that will affect their life, serviceability, interchangeability, or appearance (see 3.1).

3.15 Humidity. After completion of the tests specified in 4.7.20, the batteries shall not exhibit any degradation of safety or performance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required examinations and tests. Unless otherwise specified herein, all examinations and tests shall be performed under ambient temperature, humidity, and atmospheric pressure conditions. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment is required. Calibration standards shall be traceable to the National Institute of Standards Technology (NIST).

4.1.2.1 Instrument accuracy.

4.1.2.1.1 Voltmeters and ammeters. All voltmeters and ammeters used in testing the batteries shall be accurate within 1 percent of the full scale value. The sensitivity of voltmeters shall be not less than 10,000 ohms per volt.

4.1.2.1.2 Resistor tolerance. During all tests involving discharge through a resistance, such resistance shall be accurate within the following percentages:

	Percent
Up to and including 1 megohm	±1.0
Above 1 megohm	±5.0

In determining the resistance used as a test load, the resistance of all continuously operating voltmeters shall be considered as part of the specified load.

4.1.2.1.3 Power supplies. Power supplies used for discharges specified herein shall be accurate within ±1 percent.

4.1.2.1.4 Timing. Timing equipment shall be accurate within 0.1 percent when the measured time is greater than 120 seconds. Otherwise, the accuracy shall be 0.5 percent or better.

4.2 Classification of inspection. The examination and testing of batteries shall be classified as follows:

a. First article inspection (see 4.4).

b. Quality conformance inspection (see 4.5).

c. Periodic (annual) inspection (see 4.6).

4.3 Inspection conditions. Except as otherwise specified herein, all examinations and tests shall be performed at a temperature of 80 ±20°F.

TABLE I - Cell/Component Level Tests.

Inspection	Requirement Paragraph	Test Method Paragraph	Sampling Plan
Cell, closed circuit voltage	3.5.3	4.7.12	4.4.1.1
Cell electrolyte leakage	3.7	4.7.13	4.4.1.1
Cell forced discharge	3.7.1	4.7.18	4.4.1.1
Cell water content	3.13	4.7.17	Certification
Insulating compound, flow and shrinking	3.3.2	4.7.14	4.7.14
Cell series string insulation resistance	3.4.3	4.7.8	4.4.1.1
Cell series string voltage	3.5.4	4.7.12.1	4.4.1.1
High temperature device	3.4.5	4.7.16	20
Electrical connection wire and tabs	3.3.2.1		Certification

4.4 First article inspection. First article inspection shall be performed by the contractor, after award of contract and prior to production. First article inspection shall be performed on sample units which have been produced with equipment and procedures normally used in production.

4.4.1 Sampling plan. The number of batteries constituting an inspection lot shall be in accordance with Table I and II.

4.4.1.1 Cell level sampling plan. The total number of cells for these tests shall be equal to 4 times the number of cells in a battery. All cells shall be subjected to the closed circuit voltage and electrolyte leakage test. One half of the cells shall then be used to perform the cell forced discharge test on two separate cell strings. The other half of the cells shall be used to perform the cell series string insulation resistance and cell series string voltage tests on two separate cell strings.

4.4.2 Inspection routine. First article inspection shall consist of all the examinations and tests in accordance with Tables I and II. These tests shall be conducted in the order specified for each group. One sample battery, untested, is to remain at the contractor's plant and is to be available as a standard for comparative purposes.

4.4.2.1 Failure. If one or more sample batteries fail to meet any of the first article requirements and tests, the contractor shall immediately notify the Government of the failure. The contractor shall determine the root cause of the failure and take appropriate corrective action. The contractor is required to submit a new set of first article samples which have incorporated the changes for inspection. A description of the failure(s) and corrective action(s) taken shall be included in the first article inspection reports.

TABLE II - First-article inspection.

Group	No. of Batteries	Examination or Test	Requirement Paragraph	Method or Test Paragraph
I	See 4.4.1.1	Cell/component level tests	Table I	
II	40	Visual-mechanical	3.1	4.7.1
		Battery voltage	3.5	4.7.2
		Charge protection	3.4.5.2	4.7.10.2
		Dimensions and weight	3.1	4.7.4.
		Altitude	3.11	4.7.7
		Vibration	3.8	4.7.6
		Shock	3.9	4.7.5
		Drop	3.10	4.7.3
IIA	10	"I (and IP 1/)" test	3.6	4.7.9.1.2
IIB	10	"L (and LP 1/)" test	3.6	4.7.9.1.3
IIC	10	"H (and HP 1/)" test	3.6	4.7.9.1.4
		Negative terminal insulation (when specified)	3.1	
IID	10	State of charge	3.4.6	4.7.19
III	30	Visual-mechanical	3.1	4.7.1
	10	"HT (and HTP 1/)" test	3.6	4.7.9.1.6
	10	"LT (and LTP 1/)" test	3.6	4.7.9.1.5
	10	"IT (and ITP 1/)" test	3.6	4.7.9.1.7
IV	40 2/			
	35	Humidity	3.15	4.7.20
	30	Capacity (I, L, H and IP, LP, a HP 1/)	3.6	4.7.9.1.2 4.7.9.1.3 4.7.9.1.4
	5	Socket Strength (when specified)	3.4.8.1	3.1
		Complete discharge device (CDD)	3.4.5.3	4.7.10.1
	5	Connector (when specified)	3.4.8	4.7.15
		Safety features	3.4.4	4.7.10
V	5	Battery enclosure (when required)	3.4.7.1 and 3.4.7.2	4.7.11
VI	1	Untested reference sample		

1/ When required (see 3.1), half of the capacity samples shall be discharged in parallel.

2/ Five fresh batteries for this subgroup shall be subjected to the CDD and safety feature tests. Three fresh batteries and two humidity tested batteries shall be subjected to the CDD test. Two fresh and three humidity tested batteries shall be subjected to the safety feature test.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of Groups A, B and C inspection. Test equipment for government verification inspection shall be made available by the contractor, if required.

4.5.1.1 Group A inspection. Each battery on contract or purchase order shall be 100 percent inspected for conformance to the inspections in the order specified in Table III. All failures shall be removed Discrete lots shall be formed from batteries that pass this inspection.

TABLE III - Group A inspection.

Examination or Test	Requirement Paragraph	Method or Test Paragraph
Visual-mechanical inspection	3.1	4.7.1
Battery voltage	3.5	4.7.2

4.5.1.2 Group B inspection. Group B inspection shall consist of the tests specified in Table IV in the order shown. Sample size shall be twenty (20) randomly selected samples. Group B inspection shall be performed on sample units from each shipment lot which has been subjected to and passed group A inspection. If any battery fails any group B test, the shipment lot is rejected.

TABLE IV - Group B inspection.

Examination or Test	Requirement Paragraph	Method or Test Paragraph
Dimensions and weight	3.1	4.7.4
Insulation resistance	3.4.3	4.7.8
Safety features	3.4.4	4.7.10

TABLE V - Classification of visual and mechanical examination defects.

Categories 1/	Defects
001	Improper assembly causing parts to be inoperative or unsafe in service.
002	Electrolyte leaking caused by missing or defective sealing or closure.
101	Deformed or damaged parts which are inoperative or malfunction in service.
102	Contact surfaces obstructed by insulation material so that electrical use is affected.
103	Torn non-metallic jackets - any tear, rip, or crack with dimension greater than 1/2 inch.
104	Improper jacket closure.
105	Location, polarity and marking of terminals not as specified.
106	Labeling and marking wrong, missing or illegible so that utilization is affected.
201	Deformed or damaged parts which do not adversely affect electrical performance.
202	Burrs or imperfections which do not interfere with proper use in operation, assembly or disassembly, or cause unsafe condition in service.
203	Improper marking which doesn't hamper utilization or identification of the battery.

1/ Category 0XX defects are critical, category 1XX are major, and category 2XX are minor.

4.5.1.3 Group C inspection. Group C inspection shall consist of (a) HT and HTP (where applicable) capacity test and (b) LT and LTP (where applicable) and (c) IT and ITP (where applicable) capacity test. Each capacity test shall be preceded by both the mechanical shock and vibration tests described in paragraphs 4.7.5 and 4.7.6 respectively.

4.5.1.3.1 Sampling plan. Samples shall be selected at random in accordance with Table VI and shall represent a shipment lot. One third of the samples shall be used for the LT and LTP (where applicable) test, one third for the HT and HTP (where applicable) test and one third for the IT and ITP (where applicable) test.

4.5.1.3.2 Group C failures. Accept/reject criteria of Table VI shall be used for failures (a), (b) and (c). No failures shall be allowed for (d) (see 3.6).

TABLE VI - Group C inspection sampling plan.

Inspection Lot Size	Sample Size	Maximum number of defects
500 or less	9	0
501-1,200	15	0
1,201-10,000	21	1
10,001-35,000	33	1
35,001 or more	51	2

4.6 Group D (annual inspection). Group D inspection shall consist of the tests specified in table VII. These tests shall be performed at a maximum of 12 months after successful completion of first article testing and shall be repeated every 12 months thereafter until contract completion. This testing shall not be started prior to nine months after successful completion of first article testing. The government shall be notified immediately if any failures occur. Any failures may result in partial or complete repetition of first article testing, at the governments discretion.

TABLE VII - Group D inspection.

Examination or Test	Requirement Paragraph	Test Paragraph	Sample size
Cells			
Electrolyte leakage	3.7	4.7.13	30
Cell forced discharge	3.7.1	4.7.18	2 cell strings 1/
Batteries			20
Humidity	3.15	4.7.20	20
I and IP capacity	3.6	4.7.9.1.2	5
L and LP capacity	3.6	4.7.9.1.3	5
H and HP capacity	3.6	4.7.9.1.4	5
Complete discharge device	3.4.5.3	4.7.10.1	5

1/ The number of cells required is 2 x number of cells in the battery. Cells that have passed the electrolyte leakage test may be used.

4.7 Test methods and examination.

4.7.1 Visual and mechanical examination. Batteries and cells shall be examined to determine compliance with all applicable requirements and characteristics as specified herein (see 3.12 and Table V).

4.7.2 Battery voltage.

4.7.2.1 Open-circuit voltage. A direct current voltmeter of appropriate range and sensitivity shall be used to measure the open-circuit voltage (see 3.5.1).

4.7.2.2 Closed-circuit voltage. A direct current voltmeter of proper range and sensitivity shall be used to measure the closed-circuit voltage utilizing the load specified (see 3.5.2).

4.7.3 Drop test. Each battery shall be dropped once, for each temperature, from a height of 30 ±2 inches onto a hard surface consisting of concrete. The smallest side of the battery perpendicular to the plane of the connector face and nearest to the connector (where applicable) shall be parallel to the concrete surface and facing downward upon release, but need not be parallel upon impact. In the case of cylindrical batteries, the axis of the cylinder shall be parallel to the concrete surface upon release. The drop test shall be performed on batteries preconditioned at 130°F and -20°F. The batteries shall be stabilized a minimum of 4 hours at each test temperature and dropped within 10 minutes after removal from the temperature chamber (see 3.10). Open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 upon completion of the drop test.

4.7.4 Dimensions and weight. Batteries shall be examined by gauging or measuring and by weighing to determine conformance (see 3.4).

4.7.4.1 Dimensions. All dimensions shall include any coating which may be used, and shall remain within the specified tolerances throughout the required tests. Both minimum and maximum dimensions shall be determined. When box gauges are used, batteries, loaded with the following weights, shall pass freely through the applicable gauge openings:

a. Batteries weighing less than 5 pounds - loading weight of 5 pounds.

b. Batteries weighing 5 pounds or more - loading weight equal to the weight of the battery.

The dimensions of the box gauge shall be the specified maximum outside dimensions of the battery. Cylindrical battery dimensions shall be checked with a ring gauge meeting the above requirements.

4.7.5 Mechanical shock. Each battery shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of the battery. Each battery shall be subjected to a total of three shocks of equal magnitude. The shocks shall be applied in each of three mutually perpendicular directions for rectangular configurations or two for cylindrical configurations. Each shock shall be applied in a direction normal to a face of the battery. The faces of the battery are identified by their position in relation to the face which bears the electrical connector. For each shock, the battery shall be accelerated in such a manner that during the first 3 milliseconds the minimum average acceleration is 75 gravity units (G). The peak acceleration shall be between 125 to 175 G; exact value shall be recorded (see 3.9). Open-circuit voltage shall be measured following the tests (see 3.5.1).

4.7.6 Vibration. Each battery shall be tested in accordance with the vibration test method of UL-1642. Open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 upon completion of the vibration test (see 3.8).

4.7.7 Altitude. Batteries shall be placed in an altitude chamber, in which the pressure is maintained at a value corresponding to an altitude of 50,000 feet and the temperature is kept at 75 $\pm$5°F, for a period of six (6) hours (see 3.11). Open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 upon completion of the altitude test (see 3.11).

4.7.8 Insulation resistance (battery terminals and cell series string). Insulation resistance test shall be performed, except as otherwise specified (see 3.1). Batteries and cell series strings shall be stored for a period of 48 hours at +70 $\pm$5°F and a relative humidity of 50 $\pm$15 percent. After storage and while at these conditions, the insulation resistance shall be measured by applying a direct-current potential of 500 $\pm$20 volts between any two battery terminals or cell series string terminations not electrically connected and between all ungrounded terminals and the container of the battery. The insulation resistance of batteries and cell series strings having non-metallic containers shall be measured by the use of an appropriately sized copper plate making physical contact with the container or cell series string. The plate shall be placed with the broad surface against any areas of any surface other than that on which the battery terminals or cell series strings terminations are located (see 3.4.3).

4.7.9 Capacity (see 3.6).

4.7.9.1 Capacity tests. Sample batteries selected for capacity tests specified in the individual specification sheet (3.1) shall be stored and discharged in air as applicable, in accordance with 4.7.9.2. All batteries shall be discharged to zero volts. The time required to fall to the specified minimum voltage shall be used to determine the battery capacity. The time required to rise to the specified minimum initial voltage shall not be included in the capacity determination. A continuous temperature recording shall demonstrate the accuracy of the discharge temperature within the discharge chamber.

4.7.9.1.1 Initial voltage delay. At the start of the capacity discharge test, each battery shall be monitored with an oscillographic device or equivalent to determine the time in milliseconds required for battery closed-circuit voltage to rise to the minimum voltage after the specified loads are applied as specified in the individual specification sheets. No loads shall be applied at any time during storage or prior to the discharge test following such storage (see 3.6.1).

4.7.9.1.2 Capacity test I & IP (where applicable). Discharge at +70 $\pm$5°F without previous storage to zero volts.

4.7.9.1.3 Capacity test L & LP (where applicable). Discharge at -20 $\pm$3°F after storage at -20 $\pm$3°F for a minimum of sixteen (16) hours.

4.7.9.1.4 Capacity test H & HP (where applicable). Discharge at +130 $\pm$3°F after storage at +130 $\pm$3°F for a minimum of sixteen (16) hours.

4.7.9.1.5 Capacity test LT & LTP (where applicable). Discharge at -20 ±3°F after a minimum of four (4) weeks storage at the temperature specified in table VIII followed by a minimum of sixteen (16) hours at -20 ±3°F. No load shall be applied during the storage at the applicable high temperature and -20°F prior to discharge test.

4.7.9.1.6 Capacity test HT & HTP (where applicable). Discharge at +130 ±3°F after a minimum of four (4) weeks storage at the temperature specified in table VIII and a minimum of sixteen (16) hours at +130 ±3°F. No load shall be applied during the storage at the applicable high temperature and 130°F prior to discharge test.

4.7.9.1.7 Capacity test IT & ITP (where applicable). Discharge at +70 ±5°F after a minimum of four (4) weeks storage at the temperature specified in table VIII and a minimum of sixteen (16) hours at +70 ±5°F. No load shall be applied during the storage at the applicable high temperature and 70°F prior to discharge test.

4.7.9.2 Storage conditions. The storage conditions specified in Table VIII shall prevail during storage periods specified. A continuous temperature recording device shall demonstrate the accuracy of the storage temperature. No loads shall be applied at any time during storage prior to the discharge test following storage. Batteries shall be oriented in storage to have at least 50 percent of the cell seals at the bottom of the batteries (see 3.1).

Table VIII - Storage test conditions.

IT, HT, and LT storage conditions	Temperature (°F) ±3°F
Liquid cathode	160
Solid cathode	130

4.7.9.2.1 Discharge. Following stabilization, the batteries shall be discharged at the ambient discharge conditions as specified. There shall be at least a two (2) inch separation between all batteries that are being discharged. All batteries subjected to capacity tests shall be discharged as specified in individual specification sheets. Certification of that temperature shall be made at five equal time intervals over the test period.

4.7.10 Safety features. Each battery is to be short-circuited by connecting the positive and negative terminals of the battery with a minimum length of No. 16 AWG (1.3mm^2) copper wire, until the circuit is broken by the battery leg safety feature. The maximum current and time required to activate the safety feature shall be determined and recorded. Following the direct shorting, all batteries shall be placed at +200°F minimum for two hours. At the end of two hours the batteries shall be checked to see that no cell has vented or leaked. If any cell has vented or leaked, the battery has failed this test. If no cell has vented or leaked, the ambient temperature shall be raised to +295±5°F. This may be done in another oven. Batteries shall be maintained at an ambient temperature of +295±5°F for two hours. Any cell that vented or leaked at or below

300°F must be checked to insure that the venting occurred only through the designed vent. Venting or leakage through any portion of the cell other than the designed vent is a failure. Batteries containing cells which exploded, burned or did not vent are failures (see 3.4.4). Distortion of labeling or dimensions is permitted.

4.7.10.1 Complete discharge device. Location and operability shall be verified. Ability to discharge a fresh battery after activation of complete discharge device shall be verified during first article inspection (see 3.4.5.3). After activation, batteries shall be discharged at the ambient conditions specified in 4.3 with a minimum of two inches of space between them for a minimum of 5 days. Batteries shall meet the requirements specified (see 3.4.5.3).

4.7.10.2 Charge protection device. A DC power supply capable of delivering at least 2.50 ma. shall be used. The voltage to be used shall be 32 (+0,-1) volts, plus the voltage obtained by multiplying the number of cells in series by the maximum open circuit voltage of the cell. It shall be electrically connected with low impedance contacts to the connector terminals of series-connected cell strings of the battery to force reverse current flow (charging) through the individual cell string (i.e., positive to positive and negative to negative). This voltage shall be applied for a minimum of 1.0 second. The amount of current flowing shall not exceed the amount specified (see 3.4.5.2).

4.7.11 Battery enclosure.

4.7.11.1. Battery enclosure (plastic). Plastic jacketed batteries weighing five pounds or more shall be loaded by applying weights totaling 100 pounds evenly distributed over the top of the battery and shall remain so loaded at least one minute. The condition of the jacket shall be observed (see 3.4.7).

4.7.12 Cell closed-circuit voltage. The cells shall be tested for 5 seconds at the rate specified (see 3.1). Any cell whose voltage is not above the minimum useful voltage (i.e. for a lithium sulfur dioxide cell, 2.0 volts under load) within 5 seconds under load shall be rejected for further cell lot testing (see 3.5.3).

4.7.12.1 Cell series string voltage. The cell string voltage shall be tested for 5 seconds at the rate specified (see 3.1). Any cell whose voltage is not above two-thirds open circuit voltage within 5 seconds under load shall be rejected for further cell lot testing (see 3.5.4). The string may be retested upon repair.

4.7.13 Cell electrolyte leakage. At no time shall there be potting substance or cell jackets applied to the cells designated for this test. Each of the cells shall be weighed prior to and after filling with the electrolyte mixture. Each selected cell shall be weighed to the nearest tenth of a milligram and the weight recorded. The amount of electrolyte shall be determined for each cell based on the percentage of electrolyte used. The cells shall then be stored for one week (7 days) at the applicable temperature specified in table VIII. On the seventh day, the cells shall be tested to determine if electrolyte leakage has occurred. If electrolyte leakage is detected during the seventh day of storage, the sample has failed. If there are no failures, continue the test. At the

end of one week, the cells shall be removed from the temperature cabinet, placed in a desiccator, and cooled at room temperature for at least two hours. Each cell shall be reweighed to the nearest tenth of a milligram. After weighing, all cells shall be placed in the temperature cabinet and stored for three weeks (21 days) at the applicable temperature specified in table VIII. At the completion of this three week storage period, the cells shall be removed, placed in a desiccator and cooled for at least two hours at room temperature. Each cell shall be weighed to the nearest tenth of a milligram. The weight loss between day 7 and day 28 shall be recorded (see 3.7). If there are one or more failures, the sample has failed.

4.7.14 Flow or shrinking (insulating compounds) (see 3.3.2). Compounds shall be placed in a container, approximately 3 inches wide by 6 inches long by 3/4 inch high, to within 1/4 inch of the top. The temperature of the compound within the container shall be raised to +200 $\pm$5°F and the container shall be held in an inverted position for 24 hours. Then the compound shall be stored at -40 $\pm$5°F for eight hours minimum (see 3.3.2).

4.7.15 Connector. Connector location shall be verified by use of a mating connector mounted on a gauge within the dimensions specified (see 3.4.8).

4.7.16 High temperature device. This test shall be performed on devices prior to installation in batteries. Test sample shall be placed in a temperature chamber at +175 $\pm$5°F for a minimum of two hours. Each sample shall then be checked to verify that the device is closed. The temperature shall be raised to +190 $\pm$5°F. After 45 minutes, each sample shall be checked to verify that the device is open (see 3.4.5).

4.7.17 Cell water content. Cell water content shall be certified in the first article test report (see 3.13).

4.7.18 Cell forced discharge. A completely discharged cell (cell discharged to two-thirds of its open circuit voltage) is to be forced-discharge in accordance with method 2 of the forced-discharge test of UL-1642. One cell for each cell string shall be discharged at the rate specified (see 3.1) to a test end voltage of two-thirds of its open circuit voltage. It shall then be connected in series with the appropriate number of fresh cells which shall then be discharged at the rate specified (see 3.1) to a test end voltage of two-thirds of its open circuit voltage times the number of fresh cells in use. All cells shall comply with requirements (see 3.7.1).

4.7.19 State of charge. Five fresh batteries shall be discharged at the 10$\pm$1 hour rate to two-thirds of open circuit voltage. Calculate the average discharge rate. Discharge five fresh batteries at this rate to 80 +0, -5 percent capacity. Activate the state of charge and record the status indication. Discharge the batteries at this rate to 50 +5, -0 percent capacity. Activate the state of charge and record the indication. Discharge the batteries at this rate to 25 +5, -0 percent capacity. Activate the state of charge and record the status indication. Discharge the batteries at this rate to 5 +5, -0 percent capacity. Activate the state of charge and record the status indication (see 3.4.6).

4.7.20 Humidity. Batteries shall be tested in accordance with the humidity test of UL-1642 (see 3.15).

5. PACKAGING

5.1 Packaging requirements. The packaging requirements for the desired level(s) of protection shall be as specified by the acquisition activity.

6. NOTES

6.1 Intended use. The primary batteries included are of the non-reserve type composed of electrochemical cells. The batteries are capable of storage and use under wide temperature ranges.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.

b. Applicable specification sheet (see Supplement 1).

c. Complete type designation (see 1.2.1).

d. Requirement for first article test plan and test report.

e. Packaging requirements.

f. Government first article test requirements (when applicable).

6.3 First article. When a first article inspection is required, the item(s) should be a first article sample. The first article should consist of the number of cells and batteries specified in table II. The contracting officer shall include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Solicitations should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Definitions.

6.4.1 Non-flammable and non-toxic materials. Non-flammable and non-toxic materials are those materials which will not support combustion, produce smoke, or be capable of emitting toxic fumes when subjected to the environmental conditions specified for the battery.

6.4.2 Shipment lot. The shipment lot is the quantity of batteries (exclusive of the number of batteries required as samples) of any one type, of any one month or less, and produced at any one place of manufacture on any one contract.

6.4.3 Contract lot. The contract lot is the total of all batteries (exclusive of the number of batteries required as samples) of any one type, delivered in one or more shipment lots, under the terms of any one contract.

6.5 Examples of lusterless green. Examples of lusterless green are 34079, 34086, 34087, 34096, 34102, 34127, and 34128 per FED-STD-595.

6.6 Subject term (key word listing).
Battery
Non-rechargeable
Non-reserve

Custodians:
Army-ER

Preparing Activity
Army-ER

(Project 6135-A274)